

CLAIMS

What is claimed is:

1. A method for decoding input data, said method comprising:
  - (a) inputting a first set of symbols and a second set of symbols;
  - (b) decoding the first set of symbols and a feedback set of symbols using a decoder, thereby obtaining a first set of decoded symbols;
  - 5 (c) interleaving the first set of decoded symbols, thereby obtaining a first set of interleaved symbols;
  - (d) decoding the first set of interleaved symbols and the second set of symbols using the decoder, thereby obtaining a second set of decoded symbols;
  - (e) de-interleaving the second set of decoded symbols, thereby obtaining
    - 10 a second set of de-interleaved symbols; and
    - (f) repeating steps (b) through (e) for at least one additional iteration, wherein at each iteration the feedback set of symbols is the second set of de-interleaved symbols obtained during the immediately previous iteration.
2. A method according to Claim 1, wherein identical hardware is used for decoding in step (b) as for decoding in step (d).
3. A method according to Claim 1, wherein the decoder is an *a posteriori* probability decoder.
4. A method according to Claim 1, wherein interleaving in step (c) comprises:
  - (c1) writing the first set of decoded symbols into a buffer, row-by-row;
  - (c2) reading from the buffer and writing into a row register a row of the first
    - 5 set of decoded symbols;
    - (c3) reading from the row register and writing into the buffer the row of the first set of decoded symbols, so as to perform column interleaving;

(c4) reading from the buffer and writing into a column register a column of the first set of decoded symbols; and

10 (c5) reading from the column register the column of the first set of decoded symbols,

wherein steps (c4) and (c5) together result in row interleaving.

5. A method according to Claim 4, wherein de-interleaving in step (e) comprises:

(e1) writing into a second column register the column of the second set of decoded symbols;

5 (e2) reading from the second column register and writing into the buffer the column of the second set of decoded symbols, wherein steps (e1) and (e2) together result in row interleaving;

(e3) reading from the buffer and writing into the row register the row of the second set of decoded symbols; and

10 (e4) reading from the row register and writing into the buffer the row of the second set of decoded symbols, so as to perform column interleaving.

6. A method according to Claim 5, wherein step (c4) is performed prior to step (e2) for each column in the buffer.

7. A method according to Claim 1, wherein a single buffer is used for both interleaving in step (c) and de-interleaving in step (e).

8. A method according to Claim 1, wherein steps (b) through (e) are repeated for a predetermined number of iterations.

9. A method according to Claim 8, further comprising a step of making a hard decision for each bit position of said input data after completion of said predetermined number of iterations.

10. A method for interleaving or de-interleaving data, said method comprising:

(a) writing data into a buffer, wherein data positions in the buffer are conceptually arranged in columns of data positions and rows of data positions;

5 (b) transferring a row of the data from a selected row of data positions in the buffer and into a register;

(c) transferring the row of data from the register into the selected row of data positions in the buffer, wherein prior to step (b) the row of data was arranged in a first order in the selected row of data positions, wherein after step (c) the row of data is arranged in a second order in the selected row of data positions, and wherein  
10 the first order is different than the second order;

(d) repeating steps (b) and (c) for each row of data positions in the buffer;

(e) reading the data from the buffer; and

(f) interleaving the rows of data positions.

11. A method according to Claim 10, wherein step (f) is performed by reading the data from the buffer in a sequence so as to interleave the rows of data positions.

12. A method according to Claim 10, wherein step (f) is performed by consecutively transferring portions of the data from the buffer into a temporary register in one order and then reading from the temporary register in a different order.

13. A method according to Claim 10, wherein the data are read from the buffer in step (e) in a column-by-column fashion.

14. A method according to Claim 13, wherein step (f) is performed by reading the data from the buffer in a sequence so as to interleave the rows of data positions.

15. A method according to Claim 13, wherein step (f) is performed by consecutively transferring portions of the data from the buffer into a temporary register in one order and then reading from the temporary register in a different order.

16. A method according to Claim 13, further comprising a step of writing data into each column of data positions in the buffer, in a column-by-column fashion, after the data has been read in step (e) from said each column of data positions.

17. A method according to Claim 10, wherein a manner in which the row of data is rearranged pursuant to steps (b) and (c) is identical for each row of data positions in the buffer.

18. A method for interleaving or de-interleaving data, said method comprising:

- (a) inputting a block of data, conceptually arranged in columns of data positions and rows of data positions;
- 5       (b) writing the block of data into a buffer;
- (c) interleaving the rows of data positions;
- (d) transferring a row of the data from a selected row of data positions in the buffer into a register;
- (e) transferring the row of data from the register into the selected row of  
10 data positions in the buffer, wherein prior to step (d) the row of data was arranged in a first order in the selected row of data positions, wherein after step (e) the row of data is arranged in a second order in the selected row of data positions, and wherein the first order is different than the second order; and
- (f) repeating steps (d) and (e) for each row of data positions in the buffer.

19. A method according to Claim 18, wherein step (c) is performed by writing the block of data into the buffer in a sequence so as to interleave the rows of data positions.

20. A method according to Claim 18, wherein step (c) is performed by consecutively writing portions of the block of data into a temporary register in one order and then transferring the portions of the block of data from the temporary register into the buffer in a different order.

21. A method according to Claim 18, wherein the block of data is written into the buffer in step (b) in a column-by-column fashion.

22. A method according to Claim 21, wherein step (c) is performed by writing the block of data into the buffer in step (b) in a sequence so as to interleave the rows of data positions.

23. A method according to Claim 21, wherein step (c) is performed by consecutively writing portions of the block of data into a temporary register in one order and then transferring the portions of the block of data from the temporary register into the buffer in a different order.

24. A method according to Claim 21, further comprising a step of reading data from each column of data positions in the buffer, in a column-by-column fashion, prior to the data having been written in step (b) into said each column of data positions.

25. A method according to Claim 18, wherein a manner in which the row of data is rearranged pursuant to steps (d) and (e) is different for different rows of data positions in the buffer.

26. An apparatus for decoding input data, said apparatus comprising:  
input means for inputting coded data;  
buffering means for inputting, storing and outputting data;  
first register means for storing a portion of the data output from said buffering

5 means;

first read/write means for controlling writing of the data into said first register means and reading of the data out of said first register means so as to change the order of the data;

10 decoding means for decoding a combination of at least part of the coded data provided by said input means and the data read out of said first register means;

second register means for storing data output by said decoding means;

15 second read/write means for controlling writing of the data into said second register means and reading of the data out of said second register means so as to change the order of the data, wherein the data read out of said second register means is stored in said buffering means;

third register means coupled to said buffering means; and

20 third read/write means for transferring the data out of a portion of said buffering means into said third register means and then transferring the same data from said third register means back into said portion of said buffering means, but in a different order, and for then repeating said transferring steps for different portions of said buffering means.

5 27. An apparatus according to Claim 26, wherein data positions in said buffering means are conceptually arranged in columns of data positions and rows of data positions, wherein said first register means and said second register means are for storing a column of data, and wherein said third register means is for storing a row of data.

28. An apparatus according to Claim 27, wherein said first read/write means reads data from a column in said buffering means prior to when said second read/write means writes data to the same column in said buffering means.

29. An apparatus according to Claim 26, wherein said third read/write means is activated each time all the data in said buffering means has been rewritten.

30. An apparatus according to Claim 26, wherein said decoding means comprises an *a posteriori* probability decoder.

31. An apparatus according to Claim 26, further comprising means for making a hard decision for each bit position of input data.

32. An apparatus according to Claim 26, wherein said first register means, said second register means, and said third register means are capable of storing only a fraction of the data that said buffering means is capable of storing.

33. An apparatus for decoding input data, said apparatus comprising:

- (a) means for inputting a first set of symbols and a second set of symbols;
- (b) means for decoding the first set of symbols and a feedback set of symbols using a decoder, thereby obtaining a first set of decoded symbols;
- 5 (c) means for interleaving the first set of decoded symbols, thereby obtaining a first set of interleaved symbols;
- (d) means for decoding the first set of interleaved symbols and the second set of symbols using the decoder, thereby obtaining a second set of decoded symbols;
- 10 (e) means for de-interleaving the second set of decoded symbols, thereby obtaining a second set of de-interleaved symbols; and
- (f) means for repeating the functionality of means (b) through (e) for at least one additional iteration, wherein at each iteration the feedback set of symbols is the second set of de-interleaved symbols obtained during the immediately previous
- 15 iteration.

34. An apparatus for interleaving or de-interleaving data, said apparatus comprising:

- (a) means for writing data into a buffer, wherein data positions in the buffer are conceptually arranged in columns of data positions and rows of data positions;

5 (b) means for transferring a row of the data from a selected row of data positions in the buffer and into a register;

(c) means for transferring the row of data from the register into the selected row of data positions in the buffer, wherein prior to step (b) the row of data was arranged in a first order in the selected row of data positions, wherein after step

10 (c) the row of data is arranged in a second order in the selected row of data positions, and wherein the first order is different than the second order;

(d) means for repeating the functionality of means (b) and (c) for each row of data positions in the buffer;

(e) means for reading the data from the buffer; and

15 (f) means for interleaving the rows of data positions.

35. An apparatus for interleaving or de-interleaving data, said apparatus comprising:

(a) means for inputting a block of data, conceptually arranged in columns of data positions and rows of data positions;

5 (b) means for writing the block of data into a buffer;

(c) means for interleaving the rows of data positions;

(d) means for transferring a row of the data from a selected row of data positions in the buffer into a register;

(e) means for transferring the row of data from the register into the  
10 selected row of data positions in the buffer, wherein prior to executing means (d) the row of data was arranged in a first order in the selected row of data positions, wherein after executing means (e) the row of data is arranged in a second order in the selected row of data positions, and wherein the first order is different than the second order; and

15 (f) means for repeating the functionality of means (d) and (e) for each row of data positions in the buffer.